Write the following information in the first page of Answer Script before starting answer

ODD SEMESTER EXAMINATION: 2020-21

Exam ID Number_____

Course_____ Semester_____

Paper Code _____Paper Title _____

Type of Exam: _____ (Regular/Back/Improvement)

Important Instruction for students:

1. Student should write objective and descriptive answer on plain white paper.
2. Give page number in each page starting from 1st page.
3. After completion of examination, Scan all pages, convert into a single PDF, rename the file with Class Roll No. **(2019MBA15)** and upload to the Google classroom as attachment.
4. Exam timing from 10am – 1pm (for morning shift).
5. Question Paper will be uploaded before 10 mins from the schedule time.
6. Additional 20 mins time will be given for scanning and uploading the single PDF file.
7. Student will be marked as ABSENT if failed to upload the PDF answer script due to any reason.

M.Sc. MATHEMATICS
THIRD SEMESTER
SPECIAL THEORY OF RELATIVITY
MSM-305

Duration : 3 hrs. **Full Marks : 70**

(PART-A : Objective)

Time : 20 min. **Marks : 20**

Choose the correct answer from the following: ***1X20=20***

1. Which of the following is not a consequence of Lorentz Transformation?
a. Time Dilation **b.** Relativity of Simultaniety
c. Drag effect **d.** Length contraction

2. Special Relativity deals with:
a. Non-Uniform motion **b.** Relative motion
c. Uniform motion **d.** Absolute motion

3. Which of the following law has been proved as an invariant form by Galilean Transformation ?
a. Maxwell's law **b.** Newton's law
c. Both **d.** None of these

4. Result of Michelson Morley experiment is:
a. Non existence of ether **b.** Existence of ether
c. Correction of Einstein's Rejection **d.** None of the above

5. Absolute motion takes place when body move:
a. With reference to some other body **b.** Without reference to some other body
c. No motion **d.** None of the above

6. A Real life example of Uniform Relative motion is:
a. A Train moving in a certain direction with a certain speed relative to others **b.** A Train starts from rest
c. The earth is moving around the Sun **d.** A ball drawn downwards

7. Relativistic equation for the phenomenon of Aberration of light is:

a. $$\tan\theta = \frac{(\sin\theta')\sqrt{1+\frac{v^2}{c^2}}}{\cos\theta - \frac{v}{c}}$$

b. $$\tan\theta = \frac{(\sin\theta')\sqrt{1-\frac{v^2}{c^2}}}{\cos\theta - \frac{v}{c}}$$

c. $$\tan\theta = \frac{(\sin\theta')\sqrt{1+\frac{v^2}{c^2}}}{\sin\theta - \frac{v}{c}}$$

d. $$\tan\theta = \frac{(\sin\theta')\sqrt{1+\frac{v^2}{c^2}}}{\sin\theta + \frac{v}{c}}$$

8. The equation $divE = 0$ known as:

a. Gauss law in electricity
b. Gauss law in Magnetism
c. Maxwell's law in electricity
d. Maxwell's law in Magnetism

9. The equation $\frac{\partial F^{\mu\nu}}{\partial x^{o}} = j^{\mu}$ known as:

a. Maxwell's equation
b. Electromagnetic equation in concise form
c. Lorentz force equation
d. None of the above

10. In electromagnetic equation Value of c is:

a. $\frac{-1}{\sqrt{\mu_0 \varepsilon_0}}$
b. $\frac{-1}{\sqrt{\varepsilon_0}}$
c. $\frac{1}{\sqrt{\varepsilon_0}}$
d. $\frac{1}{\sqrt{\mu_0 \varepsilon_0}}$

11. Minkowski diagram also known as:

a. $(x-ct)$ diagram
b. $(y-ct)$ diagram
c. $(z-ct)$ diagram
d. None of the above

12. An invariant Space time interval is:

a. $\sqrt{c^2(t_2-t_1)^2 - |x_2-x_1|^2}$
b. $\sqrt{c^2(t_2-t_1)^2 + |x_2-x_1|^2}$
c. $\sqrt{c^2(t_2-t_1)^2 + |x_2+x_1|^2}$
d. $\sqrt{c^2(t_2-t_1) - |x_2-x_1|}$

13. One application of Time Dilation:

a. Problem of Pion Decay
b. Relativistic equation
c. Simultanenity problem
d. None of the above

14. In Time Dilation two events occur at:

a. One place
b. Two place
c. One or two place
d. None of the above

15. The term $1-\frac{1}{n^2}$ known as:

a. Newton's Constant
b. Maxwell's constant
c. Fresnal Drag coefficient
d. None of the above

16. Which of the following is Space-like interval?

a. $c^2 < \frac{|x_2-x_1|^2}{(t_2-t_1)^2}$
b. $c^2 > \frac{|x_2-x_1|^2}{(t_2-t_1)^2}$
c. $c^2 = \frac{|x_2-x_1|^2}{(t_2-t_1)^2}$
d. $c^2 \geq \frac{|x_2-x_1|^2}{(t_2-t_1)^2}$

17. The statement "Space and Time working together" first introduced by:

a. Lorentz
b. Galilean
c. Minkowski
d. Talman

18. Which of the following option is correct if l' measured from S' and l measured from S ?

a. $l' = l$
b. $l' < l$
c. $l' > l$
d. $l' \neq l$

19. In Lorentz force equation $F = q_0(E + u \times B)$, u represent:

a. Magnetic field
b. Velocity of the charge particle
c. Electric field
d. None of the above

20. Current density is given by:

a. $j = \sigma u$ where σ charge density, u velocity of the particle
b. $j = -\sigma u$ where σ charge density, u velocity of the particle
c. $j = \sigma \times u$ where σ charge density, u velocity of the particle
d. $j = \sigma / u$ where σ charge density, u velocity of the particle

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PART-B : Descriptive

Time : 2 hrs. 40 min. **Marks : 50**

[Answer question no.1 & any four (4) from the rest]

1. Write three consequence of Lorentz Transformation? Explain any one consequence of Lorentz transformation with Real life example. 3+7=10

2. What are the two postulates of Special Theory of Relativity? Find the Lorentz Transformation equation and derive Galilean Transformation. 2+8=10

3. What is the result of Maxwell's electromagnetic theory? Explain an experiment for establishing the result of non existence of ether. 1+9=10

4. What is charge density and current density? Prove that 4+6=10

$$j = \frac{\sigma_0}{m_0} p$$

5. What are the three types of particle discussed in Minkowski Geometry? Explain Time-like, Space-like and Light-like interval. 3+7=10

6. What do you mean by Energy-momentum tensor? Prove 6+4=10

that $\frac{\partial T^{\mu\nu}}{\partial x^{\mu}} = F^{\mu}$

7. Explain Four-Dimensional Quasi-Euclidean Flat space time. 10

8. Establish the mass and energy relation. 10

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